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For Dr. Stewart 59

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THE SEED-CORN MAGGOT, Hylemyia ciliatula Rond.,
AS A PEST OF NEWLY PLANTED SEED POTATOES IN THE COASTAL
AREA OF THE CAROLINAS;

SUMMARY OF CONTROL STUDIES, 1925 - 1930 //

CONDUCTED BY

W. J. Reid, Jr.,

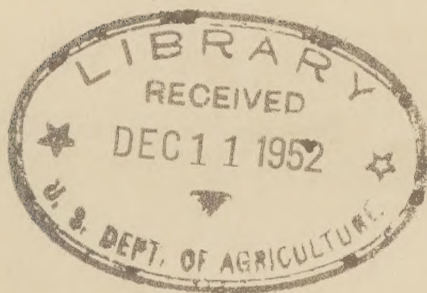
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U. S. Bureau of Entomology //

In cooperation

with

R. C. Wright
W. M. Peacock

✓
U. S. Bureau of Plant Industry //



for Mr. Stewart

THE GREEN-CORN WORM, *Heliothis virescens* Fernald,
AS A PEST OF NEWLY PLANTED SEED POTATOES IN THE COASTAL

AREA OF THE CAROLINAS

SUMMARY OF CONTROL STUDIES, 1922 - 1925

CONDUCTED BY

W. J. ELLIS, Jr.,

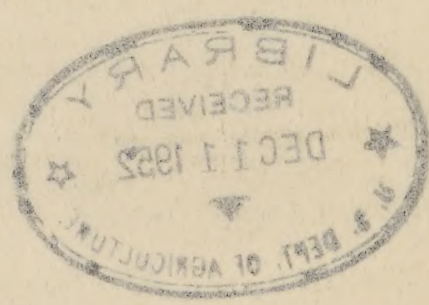
U. S. Bureau of Entomology

In cooperation

with

H. G. Wright
W. M. Pascoe

U. S. Bureau of Plant Industry



THE SEED-CORN MAGGOT, *Hylemyia cilicrura* Rond,

AS A PEST OF NEWLY PLANTED SEED POTATOES IN THE COASTAL

AREA OF THE CAROLINAS

SUMMARY OF CONTROL STUDIES 1925 - 1930

THE INSECT

The seed-corn maggot, *Hylemyia cilicrura* Rond., is widely distributed throughout the United States and is known to attack a varied group of plants. Its chief food consists of sprouting seed, such as that of beans, peas, potatoes, and corn, also tender seedlings of plants such as spinach and cabbage, and likewise decaying organic matter in the soil. Sprouting seed and seedlings that show a slight stage of decay are very susceptible to attack. The species is a temperate climate one and is most abundant and destructive in the Carolinas during the late fall and early spring months. It is most injurious during cold, wet seasons at which time seed germinations are usually slow and seed decay often prevalent.

INJURY TO THE SEED POTATO

Seed-corn maggot injury to seed potatoes results from the feeding of the maggots, or larvae of the species, on the newly planted seed-piece. The insect always enters the seed-piece through the cut surface and then tunnels itself throughout the planting unit. The degree of injury depends upon the number of larvae that attack the seed, the size of the sprout at the time of attack, the size and condition of the seed-piece, and the existing weather conditions. As many as seventy-five maggots have been found in one seed-piece, in which case the seed was completely honeycombed. Such infestations of the insect have been known to necessitate replanting of the seed. Damage of this nature is very costly to the growers because of the usual high

THE SEED CORN MAGGOT, *Hydrotaea clavigera* Rond.

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Other factors being equal, the seed-corn maggot population of a given soil, price of seed potatoes and the necessity of getting the crop on the market and consequently the possibility of a seed potato infestation depends to a large extent upon the quantity of these attractive materials in the soil. In a poor stand of weakened plants. Seed piece decay is often associated with the egg laying period of the insect. Potatoes following a crop of cabbage, spinach, or beans, especially where large quantities of the remains of these crops were left in the field, are quite liable to seed-corn maggot attack. The use of commercial fertilizers containing high percentages of organic materials and the failure to thoroughly mix these fertilizers into the soil is apt to favor maggot injury. On the other hand, it has been observed that the observation of the writer throughout the period of this series of studies

STUDIES MADE ON THE PROBLEM

Work on the potato phase of the seed-corn maggot problem was begun in 1925 in eastern North Carolina following reports of severe injury by the insect in that section. The first studies made were those of the life habits of the insect, the relation of existing farm practices to the degree of infestation or that the eggs are laid on the seed potatoes before the same are planted. The first studies made were those of the life habits of the insect, the relation of existing farm practices to the degree of infestation or that the eggs are laid on the seed potatoes before the same are planted.

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price of seed potatoes and the necessity of getting the crop on the market as early as possible. Losses from attacks of the seed-corn maggot result in a poor stand of weakened plants. Seed piece decay is often associated with attacks of the insect.

Seed-corn maggot injury to seed potatoes is often not detected by the grower, due to the fact that the injury occurs entirely under ground. Poor stands and weak plants resulting from the feeding of the insect are often attributed to such other factors as poor seed, faulty cultivation of the seed, dry, and to unfavorable weather conditions.

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Work on the potato phase of the seed-corn maggot problem was begun in 1925 in eastern North Carolina following reports of severe injury by the insect in that section. The first studies were made with those of the life habits of the insect, the relation of existing farm practices to the degree of insect injury, and the feeding in field experimental plots of a number of other insects as possible interferences. The studies were continued in Pamlico County North Carolina during 1926. In 1927 the work included several observations of the insect's injury to seed potatoes in eastern North Carolina. Extensive damage was reported as occurring in that area in the winter of 1928.

RESULTS OF PRELIMINARY CONTROL STUDIES

Outstanding results of the work for these three seasons were as follows: A study of the seed-corn maggot are strongly attracted by partly decayed plant remains to sprouting seed, and to high nitrogenous material in commonly used in this area, cotton seed meal, fish meal, and other animal products. The female fly is attracted to these materials when present in the soil and lays her eggs in the soil on or near these materials. The remains of a crop of cabbage, spinach, beans, or peas serve as ideal oviposition substrates.

Other facts being equal, the seed corn maggot population of a given soil, and consequently the possibility of a seed potato infestation depends to a large extent upon the quantity of these attractive materials in the soil during the egg laying period of the insect. Potatoes following a crop of cabbage, spinach, or beans, especially where large quantities of the remains of these crops were left in the field, are quite liable to seed-corn maggot attack. The use of commercial fertilizers containing high percentages of organic materials and the failure to thoroughly mix these fertilizers into the soil is apt to favor maggot injury. On the other hand, it has been the observation of the writer throughout the period of this series of studies that potatoes planted in a soil comparatively free of these attractive organic materials are not subjected to seed-corn maggot injury. This is evidently due to the small maggot population of such soils. The writer has seen no evidence that planted seed potatoes serve as attractants to the fly for egg laying or that the eggs are layed on the seed potatoes before the same are planted.

No chemical treatment of seed potatoes has been found to be efficient in the control of the seed-corn maggot. Because of the nature of the attack such treatments, to be effective, would have to be made after the seed was cut. With the exception of sulphur, the chemicals that were tested only served to increase the insect infestation. This increase is apparently due to a burning or breaking down of the tissues of the cut surface of the seed by the chemicals. Any formation of scum on the cut surface of a potato seed-piece serves to induce seed-corn maggot attack. During the 1927 season some benefit was derived from rolling freshly cut seed in finely ground dusting sulphur. This treatment did not show up so well in tests of the following season.

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The most significant outcome of the control studies of the first three

seasons was the observation that, regardless of the type of soil, previous crop, or nature and method of application of fertilizer, those potato seed pieces which became thoroughly healed soon after being planted were not attacked by the seed-corn maggot. Under favorable conditions potato seed pieces will heal normally in the soil. However, these favorable conditions are not always, or not even commonly found to exist at the time the early crop is planted in the Carolinas. The soil at that time is very apt to be cold and wet. Instead of a firm periderm layer being formed the cut surface of seed planted in late January and February in the Carolinas is likely to be covered by a thin layer of brown scum. This scum, which is disintegrated tissue and in itself apparently not harmful, is definitely known to attract maggots to the seed piece and serve as food for young larvae. After feeding a short while on this scum the insect tunnels into the firm portion of the seed piece. The larvae do not appear to be able to obtain food from the cut surface of a well corked seed piece. As a result of these findings our attention was turned to the possibility of using suberized, or corked, seed potatoes as a means of preventing seed-corn maggot attack.

COOPERATIVE SEED SUBERIZATION STUDIES

Since it was definitely shown that the seed-corn maggot and accompanying decays do not attack whole tubers and those whose cut surfaces have thoroughly corked, the assistance of workers of the U. S. Bureau of Plant Industry was sought and obtained. The results of their past studies were used in further work on the seed-corn maggot problem.

In these cooperative studies the Bureau of Plant Industry was represented by Messrs. H. C. Wright and W. M. Peacock and the Bureau of Entomology represented by the writer. The work was conducted during the seasons of 1928, 1929, and 1930 in the vicinity of Charleston, S. C. on the farms of Messrs.

J. H. Harrison and L. B. King, to whom we are indebted for their generous assistance throughout the period of the investigation.

Field studies on the seed potato phase of the problem were transferred from Pamlico County, N. C. to Charleston, S. C. for the following reasons:

1. The fact that the insect was known to be very destructive to seed potatoes in the South Carolina area as well as in North Carolina.

2. The fact that the Charleston, S. C. growers were greatly interested in the problem and were willing to give better cooperation than had been received elsewhere.

3. Since one worker had under way at Charleston work on other phases of the seed-corn maggot problem.

4. Also since Charleston, S. C. offered the better working facilities.

THE EXPERIMENTS

Cooperative studies of the 1929 season consisted of a comparison in field experimental plots of seed potatoes planted immediately after being cut, the usual commercial practice, with seed that had been cut and stored in the grower's storage house. A limited number of seed subjected under controlled storage conditions at Arlington Park, Va. were included in the tests.

During the 1929 and 1930 seasons the curing process was carried on in both grower's storage conditions and in a specially constructed room where temperature and humidity could be better controlled. This room, located in a farm building was lined with Celotex, a semi-pulp insulating board, and was heated with a small poultry brooder stove. A high humidity was maintained by wetting the earthen floor of the room and having numerous moist sponges near the stove. The 1929 and 1930 work included the comparison of seed that had been cut after being cut for planting for different time periods in both types of storage. The dates of planting the experimental plots were arranged to cover the entire commercial planting season. The field plots were located

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on at least three different farms, consisted of rows at least 150 feet long, and carried four replications of each seed treatment.

The degree of insect infestation of the various plots was determined by removal and careful examination of twenty-five seed pieces each week from rows representing the different seed treatments. One replication was examined each week. As the seed-corn maggot infestation period usually lasts about one month, the entire experimental plot was covered in the seed-piece examinations. Records were made of the number of maggot-infested seed, the number of larvae feeding on each seed-piece, progress of germination, and the condition of the seed. Stand counts were made when approximately one-half the plants had appeared above ground. Final plant counts were made when germination was complete. Field records were obtained by careful harvest, grading and weighting of all tubers produced by each plot.

It proved that the sites selected for the 1933 field experimental plots were too nearly ideal for potato production for a fair test of the value of sterilized seed. The soils were well drained, free of previous crop residues and weather conditions were favorable for germination. As a result the seed planted freshly will heal in the soil soon after being planted. There was no appreciable seed-corn maggot infestation or decay of either type of seed, small but plant stands were obtained and yields were high.

The experimental plots of the two following seasons were located in fields representing more varied soil conditions and in which there would be greater possibility of insect attack and seed-piece decay. The facts of these two years were planted under all conditions that are normally encountered by growers in the Charleston, S. C. area.

The following table gives a summary of all plant stands, seed-corn maggot infestations, and yield data obtained from the seed sterilization field

Statistics of 1923, 1924, and 1925 and the Average for the three years.

SUMMARY OF DATA ON SEED POTATO SUBERIZATION EXPERIMENTS

CONTROLLED STORAGE

FRESHLY CUT SEED

Year	Plant Stand Percentage	Seed-Corn Maggot Infestation Percentage	Yield	
			Bu. per Acre U. S. #1	Others
1923	<i>No Test</i>	—	—	—
1924	90.1	87.2	167.8	51.3
1925	98.0	11.1	111.5	51.1
Av.	94.7	39.1	140.3	51.1

COOKED SEED

1923	<i>No Test</i>	—	—	—
1924	98.2	0.65	152.7	51.6
1925	98.5	1.0	126.9	53.8
Av.	98.5	0.82	140.8	54.2

GROWERS STORAGE

FRESHLY CUT SEED

1923	98.0	<i>None</i>	284.5	56.8
1924	96.4	86.5	147.1	52.2
1925	99.1	7.5	139.5	50.1
Av.	97.8	37.0	190.4	46.4

COOKED SEED

1923	98.7	<i>None</i>	211.7	55.5
1924	97.5	7.1	157.6	41.3
1925	94.4	0.4	127.8	54.6
Av.	97.5	3.7	165.1	43.7

RELATION OF SEED-CORN MAGGOT TO POTATO SEED PIECE DECAY

During the spring seasons of 1927 and 1928 studies on this phase of the problem were conducted at Charleston, S. C. by Mr. Jainer Smith, employed at the time by the Bureau of Plant Industry.

PLANS FOR FUTURE WORK

Since our seed potato tuberization studies at Charleston, S. C. have given very satisfactory and comparable results for three consecutive seasons, it does not seem necessary to continue the work in that area. However, for the reasons outlined below another season's work in North Carolina seems highly desirable.

It will be remembered that our first work on the seed-corn maggot problem was conducted in Pamlico County, North Carolina, the scene of frequent losses from insect injury and seed-piece decay. There are sufficient differences in conditions existing at Charleston, S. C. and Pamlico County, N. C. to justify a season's work on potato tuberization in the last named area.

A list of the most outstanding differences follows:

1. The Soils:

Charleston, S. C. — Sandy loam soils that are usually adequately drained and which do not normally contain much decaying organic matter.

Pamlico, N. C. — Red mixed swamp soil that is usually poorly drained and contains large quantities of decaying organic matter attractive to the seed-corn maggot.

2. Weather:

	Charleston, S. C.	Pamlico, N. C.
Normal Yearly Rainfall	47.07 inches	56. 47.79 inches
Normal Potato Season "	13.57 "	16.00 "
Daily Mean Temperature — Year	66.0°	62.6°
" " " Potato Season "	51.0°	51.3°

3. Potato Planting Conditions:

Charleston, S. C.

Commercial potato planting begins in late January and continues throughout February. Under average conditions germination begins

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at once and progresses rapidly. Seed subject to seed-corn maggot injury three to four weeks.

Pamlico, N. C.

Commercial potato planting covers approximately the same period as in South Carolina, the early start being considered necessary in order that the growers may get in their entire crop as early as possible. Planting operations are more often interrupted and delayed by unfavorable weather conditions in this section than in the South Carolina area. Germination in Pamlico, N. C. is slower and the seed subject to insect injury and decay for a longer period. Seed subject to insect injury and decay for four to six weeks.

note

The observations of the ~~writer~~ have been that potato seed planted freshly cut, the usual commercial practice in both sections, do not heal normally in the soil as readily under the Pamlico, N. C. conditions as at Charleston, S. C. This is probably due to the difference in weather and soil conditions and the fact that the sticky nature of the Pamlico soils often causes them to adhere to the cut surface of the seed pieces. Under such conditions it is quite possible that seed suberization before planting will prove to be of even greater value in the North Carolina area than our experiments show for the areas further south.

Working Facilities at Pamlico, N. C.

A recent visit by the writer to the Pamlico area revealed that the growers in that area are greatly interested in the development of the ~~pro~~ ^{plan} during the last three seasons and are willing to cooperate in every way possible should further work be located in their section. They state that the ~~idea~~ ^{plan} of cutting and healing their seed potatoes before the rush of the planting operations will be of great help to the average grower.

Mr. D. C. McCotter of Cash Corner, N. C. has a recently constructed

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sweet potato curing and storage house, one room of which will be available for our seed suberization chamber. The rooms are lined throughout with the cane-pulp insulating board, Calotax, and the temperature of each room can be controlled by forced draught ventilation.

It might be well for us to determine if this type of building, which is quite ~~numerous~~^{common} in the coastal areas of the Carolina, can be used for potato seed suberisation.

The Pamlico, N. C. area can now be reached over paved roads from New Bern, N. C., which ^{Town} offers suitable living conditions.

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The building, N. C. area can now be reached over paved roads from New Town, N. C., which offers suitable living conditions.

